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The Influence of Brain Abnormalities on Psychosocial Development, Criminal History and Paraphilias in Sexual Murderers*

ABSTRACT: The aim of this study was to investigate the number and type of brain abnormalities and their influence on psychosocial development, criminal history and paraphilias in sexual murderers. We analyzed psychiatric court reports of 166 sexual murderers and compared a group with notable signs of brain abnormalities ($N = 50$) with those without any signs ($N = 116$). Sexual murderers with brain abnormalities suffered more from early behavior problems. They were less likely to cohabitate with the victim at the time of the homicide and had more victims at the age of six years or younger. Psychiatric diagnoses revealed a higher total number of paraphilias: Transvestic fetishism and paraphilias not otherwise specified were more frequent in offenders with brain abnormalities. A binary logistic regression identified five predictors that accounted for 46.8% of the variance explaining the presence of brain abnormalities. Our results suggest the importance of a comprehensive neurological and psychological examination of this special offender group.

KEYWORDS: forensic science, forensic psychiatry, sexual homicide, brain abnormalities, paraphilia, sexual offender

Brain abnormalities like lesions (particularly at the temporal and frontal lobes, but also diffuse/bilateral), head injuries and epileptic disorders may increase aggressiveness through cognitive impairment and diminished inhibitory control (1). Little is known about the role of brain abnormalities in sexual murderers. Langevin et al. (2) found temporal lobe abnormalities in 30% of sexual murders [$N = 10$] versus 40% of non-homicidal sexually aggressive offenders [$N = 10$] and 0% of non-sex murderers [$N = 10$]. In a later study of 33 sexual murderers, Langevin (3) described seizures in 6% [$N = 2$], neurological diagnoses in 18% [$N = 6$], birth abnormalities in 21% [$N = 7$], and early head injuries causing unconsciousness in nearly 40% [$N = 13$]. Sixty four percent of the sexual murderers showed abnormal results on neuropsychological tests, and most were of average intelligence. Myers (4) investigated juvenile sexual murderers [$N = 16$] and found one or more neuropsychiatric vulnerabilities in all subjects (damage from trauma, infections, anoxia or intrauterine exposure to alcohol in 69% [$N = 11$], chronic headaches/migraine in 38% [$N = 6$], and seizures and/or EEG abnormalities in 25% [$N = 4$]. Stone (5) reviewed biographies of perpetrators of serial sexual homicide with three ore more victims. In 19 of 89 (21%) biographies he found material suggesting traumatic head injuries. Meloy (6) hypothesized a bimodal distribution in sexual homicide perpetrators according to their biological predisposition: those that are hyporeactive, and may need high levels of (perhaps sexual) stimulation; and those that are hyperaroused, and may need little kindling to be activated.

Raine (7) proposed the hypothesis that there is a tendency for frontal dysfunction to be associated with violent offending (rape included), while temporal dysfunction is associated with paraphilias like sadism or pedophilia. For example, in two case reports about neurologically abnormal pedophilic patients (8) positron emission tomography revealed a prominent right temporal lobe hypometabolism. Other empirical data, however, reveal no specifity between damage in any distinct brain area and paraphilias (9). Hendricks et al. (10) investigated 16 child molesters by computed tomography scans and regional cerebral blood flow (rCBF) estimations. Compared with controls, child molesters were found to have thinner and less dense skulls and lower rCBF values. Aigner et al. (11) compared a group of violent with nonviolent sexual offenders [$N = 50$] and found relatively more cases (59.4%) of non-specific brain abnormalities detected by MRI in the violent than in the nonviolent (22.2%) group. Eher et al. (9) compared 17 sexual offenders with structural brain abnormalities measured by MRI with 21 without abnormalities and found a relatively higher number of violent sexual offenses (75.5% vs. 47.6%) in the group with structural abnormalities.

There is no study with a larger sample investigating the possible role of neurological abnormalities in sexual homicide perpetrators. Since studies could not show a specifity between damage in any distinct brain area and paraphilias or sexual offenders in general, we decided to first compare those sexual murderers with any indication of brain abnormalities with those without such signs and to assess

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the influence on psychiatric history and diagnoses. Consistent with the literature on non-homicidal sex offenders (9,11), our main hypotheses were that the group with brain abnormalities would show more problems in psychosocial development, more violence during the homicidal act, and more paraphilias.

Methods

Psychiatric court reports on 166 men who had committed a sexual homicide between 1945 and 1991 were retrospectively evaluated by three raters (PB, NH, AH) between June 2002 and September 2003. The three raters were experienced forensic psychiatrists (AH, PB) or psychologist (NH) and trained for this study using a manual that included definitions of the rating criteria.

The reports had been written by 20 different forensic psychiatrists. To minimize selection bias we asked four major German institutions[5] of forensic psychiatry to send us all their available reports on sexual murderers who committed the homicide between that period.[6] Adopting Ressler et al.'s (12) *definition of sexual homicide*, we included only reports on homicide offenses in which at least one of the following criteria was fulfilled:

- Attempted or completed sexual intercourse (oral, anal, vaginal),
- Exposure of the primary or secondary sexual parts of the victim's body,
- Victim attire or lack of attire,
- Sexual positioning of the victim's body,
- Insertion of foreign objects into the victim's body cavities,
- Semen on or nearby the victim's body,
- Substitute sexual activity,
- Sexual interest admitted by the offender
- Sadistic fantasies admitted by the offender.

The mean number of criteria for sexual homicide per offender was 3.7 (SD 1.5, range 1–7).

The reports were originally requested to assess criminal responsibility (112/166, 67.5%) or for risk assessment prior to release or changes in security levels of imprisonment (54/166, 32.5%). The reports (mean length 58 pages, SD 35, range 8–208) were based on external information (attorney, court, witnesses, relatives, former psychiatric and psychological assessments), psychiatric exploration and examination, and physical and psychological assessments. Additional information was evaluated by the raters if available (psychological tests, neurophysiologic and neuroimaging assessments, former forensic reports, court verdicts etc.). Neuroimaging was rarely conducted (60/166, 36.1%), partly because most reports were done between 1969 and 1991 and neuroimaging was not conducted routinely in forensic psychiatry. EEG results were available for 134/166 (80.7%) persons.

The material was evaluated using a computerized form including sociodemographic characteristics, psychiatric, and sexual history. Psychiatric disorders (including paraphilias) were diagnosed by the raters according to DSM-IV criteria (13).

Interrater reliability was assessed by evaluating 20 reports by all three raters and obtaining a consensus rating for each item. For DSM-IV axis one disorders Kappa coefficients ranged between 0.61 and 1.0 (mean $\kappa = 0.82$).

Grouping Variables and Statistical Analysis

To test our hypotheses, we divided the subjects into two groups for comparison: a group with indications of brain abnormalities (BA group) and a group with the sexual murderers without such indications (non-BA group). Brain abnormality was *defined* as neurological disorder (epilepsy, traumatic brain injury, encephalitis/meningitis causing brain damage, genetic disorder), pathological neuroimaging and/or EEG results. Cases that were mentioned as clearly pathologic by the forensic psychiatrist who wrote the report but did not receive a distinct diagnosis were also included as "brain damage not specified."

Between-group comparisons were undertaken using two tailed t-tests for normally distributed data, Mann-Whitney U tests for nonparametric continuous data, χ^2 analyses for binary data (with Bonferoni correction for multiple comparisons) and odds ratios with 95% confidence intervals. Fisher's exact test was calculated for binary data if one cell showed an expected frequency below five. In the secondary analysis predictors of brain abnormalities were sought with a stepwise binary logistic regression (forward selection). To limit the number of potential predictor variables, only those variables in which differences had been found between sexual murderers with and without brain abnormalities in the primary analysis were entered in the regression analysis. Significance was set at $p \leq 0.05$ for variable entry into the equation. Statistical analysis was performed using SPSS 11.5 (SPSS Inc., Chicago, 2003).

Sociodemographic Variables

All demographic variables derived from archival sources were based on the incidence of behaviors associated with the first offense, even in subjects with multiple offenses. The sample consisted exclusively of Caucasian offenders, 97.6% (162/166) were German. Over twenty one percent (36/166) had killed more than one victim. The definition of multiple murderers was restricted to those who committed sexual homicides at two or more distinct occasions. Their prevalence was lower (26/166, 15.7%), including nine (5.4%) so-called serial killers with three or more distinct sexual murders. The total number of victims amounted to 227 (169/227, 74.4% females; 58/227, 25.6% males) of whom 21.6% (49/227) were children (3–14 yrs).

Offenders' mean age at time of the first sexual homicide was 26.5 yrs (SD 8.2, range 15.5–58.7), 11.4% (19/166) of the offenders were adolescents under the age of 18. The majority was either single (120/166, 72.3%) or divorced/living apart (23/166, 13.9%), only 13.9% (23/166) were married; 27.1% (45/166) lived in a relationship, 25.3% (42/166) had at least one child. School performance was poor: 37.6% (62/166) were without any formal school degree, 9.7% (16/166) attended special education classes/schools, i.e. for children with learning and behavioral difficulties, 49.6% (82/166) completed pre-high school education (9–10 yrs) and 3.0% (5/166) finished high school (13 yrs, regular duration for German high school degree). Only 27.7% (46/166) completed an occupational training (2–3 yrs), and only 0.6 (1/166) finished a university degree (4 – 6 yrs). 29.5% (49/166) were unemployed at the time of the homicide. This low educational and occupational status contrasts to the groups average intelligence as ascertained by the

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[6] The majority (78%) of reports were written by E. Schorsch, the former director of the Institute of Sex Research and Forensic Psychiatry at the University Hospital Hamburg-Eppendorf. We restricted the time of offense to the period between 1945 and 1991—again to minimize selection bias, because we did not have reports on sexual homicides after 1991 by E. Schorsch who died at the end of that year.

Hamburg Wechsler Adult Intelligence Scale, a German version of the Wechsler Adult Intelligence Scale (14): the mean full-scale IQ was 101.5 (SD 13.8, range 67–143) for those offenders with formal intelligence tests (119/166) and only one subject had an IQ below 70. Forty percent (66/166) of the offenders were still living with their parents, 51.2% (85/166) lived independently, 6.0% (10/166) were in institutions, and 3.0% (5/166) were homeless.

Results

Brain Abnormalities

Thirty-one percent (50/166) of the whole group showed any indication of brain abnormalities. Diagnoses (multiple abnormalities were possible) included epilepsy, traumatic brain injuries (in eight persons before the age of 12 years), and childhood encephalitis/meningitis causing brain damage, genetic disorders (3/50 with XYY karyotype). In sixteen men brain damage was not specified. Pathological neuroimaging results were established in 17 of 60 (34%) persons in whom measurements were taken. Pathological EEGs were assessed in 29 persons (EEG was conducted in 134 persons, 21 (15.6%) men with normal variants were *not* included into the BA group). Thirty persons showed one, 14 two and 6 three ore more different signs of brain abnormalities. To control for a possible selection bias for neuroimaging and/or EEG, we compared the number of investigations in both groups and found no difference according to EEG, but we did for neuroimaging ($p < .05$), which was conducted more often in the BA group.

TABLE 1—*Indications of brain abnormalities in 166 sexual murderers.*

Indications of brain abnormalities (multiple abnormalities possible)	*N*	%
Epilepsy	12/166	7.2
Traumatic brain injuries that caused unconsciousness	14/166	8.4
Encephalitis/meningitis in childhood	7/166	4.2
Genetic disorder	3/166	1.8
Hydrocephalus internus	2/166	1.2
Brain damage not otherwise specified	16/166	9.6
Pathological neuroimaging results	17/60	28.3
frontal abnormalities	5/60	8.3
dilatations of the lateral ventricles	6/60	10.0
diffuse white matter lesions	2/60	3.3
generalized brain atrophy with dilatation of the cerebrospinal fluid system	1/60	1.6
prolactinoma	1/60	1.6
Non-specific abnormalitites	2/60	3.3
Pathological EEGs (multiple abnormalitites possible)	29/134	21.6
epileptiform activity	12/134	9.0
paroxysmal activity	5/134	3.7
diffuse slowing	7/134	5.2
non-specific abnormalities	11/134	8.2

Sociodemographic Data, Social Background, and Sexual Development

No significant group differences were found in age, marital status and current partnership at the time of the first sexual homicide. Although mean full-scale IQ, as measured by the Hamburg Wechsler Adult Intelligence Scale (14), was significantly lower in the BA group (97.1, SD 12.6 vs. 103.3, SD 12.9; $t = -2.39$, df = 117, $p = .018$), school performance and professional degree showed no significant differences: forty-four percent (22/50) of the BA group vs. 34% (39/116, ns) of the other men were without any formal school degree and 40% (20/50) vs. 24.1% (28/116, ns) were unemployed at the time of the offence.

Subjects of the BA group felt more isolated (41/50, 82% vs. 74/116, 64%; $\chi^2 = 6.20$, $p \leq .05$, ns after Bonferoni correction) and teased by others (31/50, 62% vs. 46/116, 39.7%; $\chi^2 = 7.92$, $p \leq .05$ ns after Bonferoni correction) during childhood. The total number of childhood behavior problems was higher in the BA group (mean: 4.1 SD 2.1 vs. 3.2 SD 1.9; U= 2101.0, $z = -2.6$, $p = .01$). However, the comparison of single behavior problems across the groups revealed no significant differences: daydreams (14/50, 28% vs. 14/116, 12%), enuresis/encopresis (18/50, 36% vs. 27/116, 23.3%), chronic lying (9/50, 18% vs. 13/116, 11.2%), school problems (41/50, 82% vs. 78/116, 67.2%), repeating classes (28/50, 56% vs. 52/116, 44.8%) and symptoms of attention-deficit/hyperactivity disorders (10/50, 20% vs. 18/116, 15.5%). There were also no group differences in suffering from physical maltreatment (38/50, 76% vs. 80/116, 69%) and/or sexual abuse (10/50, 20% vs. 26/116, 22.4%). Age at first masturbation (14 yrs) and sexual intercourse (17 yrs) was nearly the same for both groups.

Criminal History

The two groups differed only in previous arsons (7/50, 14% vs. 5/116, 4.3%; $\chi^2 = 4.89$; $p = .03$, ns after Bonferoni correction), but not in any other offence category (non-violent non-sex offenses, sexual offenses, or other violent offenses).

Psychiatric Diagnoses

Transvestic fetishism and paraphilias not otherwise specified ($N = 2$ with sodomy, $N = 4$ with necrophilia, $N = 1$ with urolagnia, $N = 1$ with corpophilia, $N = 1$ with frotteurism) were diagnosed more often in men of the BA group. Sexual sadism was also more frequent, but not significant after Bonferoni correction. There was no difference in the prevalence of pedophilia. The number of paraphilias per offender was higher in the BA group (mean: 1.2, SD 1.2 vs. 0.7, SD 0.8; U= 2155.0, $z = -2.83$, $p = .005$). All three men with genetic disorders and 50% (6/12) with epilepsy were diagnosed as sexual sadistic.

Comorbid (non-sexual) DSM-IV axis I disorders revealed no differences between groups except less alcohol abuse and addiction in the BA group (15/50, 30% vs. 63/116, 54.3%; $\chi^2 = 8.29$, $p = .004$; OR = 0.36; 95% CI 0.18–0.73).

Sexual Homicide Characteristics

Twenty-eight percent (14/50) of the BA group versus 19% (22/116, ns) of the other men committed more than one sexual homicide. Most of the victims were strangers to the offenders (36/50, 72% vs. 66/116, 56.9%; ns). Although the prevalence of pedophilia did not differ between the two groups, more victims of the BA group were at the age of six years or younger (10/50, 20% vs. 9/116, 7.8%, $\chi^2 = 5.17$; $p = .023$; OR = 2.97, 95% CI 1.13–7.85, ns after Bonferoni correction). Men of the BA group reported that they were more often sexual aroused by the pain and fear of the victim (19/50, 38% vs. 23/116, 19.8%; $\chi^2 = 6.12$; $p = .05$, ns after Bonferoni correction) and during the homicidal act (20/28,71% vs. 28/69, 40.6%; $\chi^2 = 7.58$, $p = .006$; OR = 3.66, 95% CI 1.42–9.47). Men of the BA group attempted and completed cohabitation less often (17/47, 36.2% vs. 64/108, 59.4%; $\chi^2 = 6.99$; $p = .008$; OR = 0.39, 95% CI .19–.79) and were more likely to insert foreign objects into the victim's vagina (7/50, 14% vs. 4/116, 3.4%; $\chi^2 = 6.29$; $p = .012$; OR = 4.56, 95% CI 1.27–16.36). There was significantly less influence of alcohol at the time of the homicide in the BA group (24/50, 47.9% vs. 81/116, 69.6%; $\chi^2 = 6.83$, $p = .009$; OR 0.40, 95% CI 0.20–0.80).

TABLE 2—*DSM-IV paraphilic disorder diagnoses in 166 sexual murderers.*

	With Brain Abnormalities ($N = 50$)		Without Brain Abnormalities ($N = 116$)		Analysis			
Paraphilias	*N*	%	*N*	%	χ^2(df = 1)	*p*	OR	95% CI
Any Paraphilia	31	62.0	55	47.4	2.98	.084	1.81	0.92–3.56
Sadism	25	50.0	36	31.0	5.41	.020	2.22	1.13–4.39
Masochism	3	6.0	6	5.2	0.05	.829	1.17	0.28–4.88
Pedophilia	7	14.0	14	12.1	0.12	.731	1.19	0.45–3.14
Transvestic Fetishism	8	16.0	2	1.7	12.58	.001*	10.86	2.22–53.21
Fetishism	1	2.0	4	3.4	0.25	1.0	0.57	0.06–5.25
Exhibitionism	2	4.0	4	3.4	0.31	1.0	1.17	0.21–6.59
Voyeurism	5	10.0	5	4.3	2.00	.170	2.47	0.68–8.94
Paraphilia NOS	9	18.0	4	3.4	10.25	.003*	6.15	1.80–21.04

* Statistically significant difference ($p < .005$, Bonferroni corrected for $1 \times .9$ comparisons).

Logistic Regression Model

To assess which characteristics of the sexual murderers and their offenses predict belonging to the group with brain abnormalities, we performed a binary logistic regression. The resulting factors could give hints to the clinician or the forensic expert to search for possible brain abnormalities. Five factors were identified to be significant predictors of belonging to the group with brain abnormalities: transvestic fetishism (OR 10.56, 95% CI 2.15–51.94, Wald = 8.42, $p = .004$), paraphilias not otherwise specified (OR 4.68, 95% CI 1.22–17.91, Wald = 5.07, $p = .024$), insertion of foreign objects into the victim's vagina (OR 8.53, 95% CI 1.57–46.35, Wald = 6.15, $p = .013$), victims age of six years or younger (OR 4.73, 95% CI 1.65–13-53, Wald = 8.39, $p = .004$), and the absence of alcohol abuse/addiction (OR 0.31, 95% CI 0.13–0.78, Wald = 6.32, $p = .012$). These factors accounted for 46.8% of the variance explaining the presence of brain abnormalities and for 90.5% of their absence.

Discussion

Our results show a high prevalence (30%) of heterogeneous brain abnormalities in sexual homicide perpetrators. This rate is in accordance with former studies (2–5,15), but lower than the rate found by Blake et al. (16) in their specific study on neurological abnormalities in 31 (non-sexual) murderers. They found abnormalities in 97%, evidence of frontal dysfunctions in 64.5%, and of temporal dysfunctions in 29%. The history of severe physical abuse in 83.8% and sexual abuse in 32.3% of their sample led the authors to the conclusion that a history of abuse, paranoid symptoms and brain dysfunctions may interact to form violent behavior.

Assessment of EEGs in our study was in the range of previous studies that found abnormalities in 24% to 78% of violent non-sexual offenders or murderers, more frequently if there was no apparent motive to the crime (1).

Our results also show a more specific association of brain abnormalities with transvestic fetishism, paraphilias NOS and sexual sadism. In his seminal paper Brittain (17) described that transvestic fetishism often occurs in sadistic murderers. Fedora et al. (18) also described a high co-occurrence of sadism, transvestism and other paraphilias in sex offenders. The meaning of the association, i.e., whether it is cause, effect or epiphenomenon—between the investigated brain abnormalities, transvestic fetishism, the more rare or bizarre paraphilias and violence is unclear, partly because the investigated group was very heterogeneous. In subjects with brain disorders a stronger vulnerability might correlate more often with paraphilias and sexual violence and might require less influence of other negative life experiences. Raine et al. (19) showed that non-sexual murderers without any clear signs of psychosocial deprivation were characterized more by prefrontal deficits than those with traumatizing events like child abuse. Our findings of a substantial frequency of brain abnormalities and paraphilic psychopathology are also consistent with the hypothesis involving the importance of neurodevelopmental contributions in the genesis of serial sexual homicide (20,21).

In our study, the men with brain abnormalities suffered more from chronic isolation and teasing by others in childhood, which could indicate their early relationship, peer group and attachment problems (22). Early behavior problems and paraphilias, which occurred more often in the BA group, could possibly develop as a reaction to feeling insufficient and inferior in comparison to peers. This would confirm early theories of organic disorders in paraphilias that feelings of inferiority are associated with paraphilic behaviors and fantasies, particularly in sexual sadism (23). This mechanism could also explain that the BA men were less likely to cohabitate during the sexual homicide, but inserted more often foreign objects into the victim's orifices. However, it has to be addressed that there is a strong relationship between "psychopathic" (24) and sadistic personality traits (25). Porter et al. (26) could show that nearly 85% of the sexual homicide perpetrators investigated in their study scored in the moderate to high range on the "Psychopathy Checklist-Revised" (24) and that psychopathic offenders showed a significantly higher level of sadistic violence. "Psychopathy" can manifest in manipulation, so it may be possible that subjects in our study were malingering low self esteem to mitigate responsibility for their offence. The fact that significantly fewer offenders in the group with brain abnormalities suffered from alcohol problems and offended under the influence of alcohol could indicate that these individuals need less disinhibiting factors to commit a homicide.

Our results suggest the importance of a precise neurological and psychological examination of this specific offender group not only to evaluate responsibility but also for treatment and risk assessment. Our regression analysis revealed five predictors as hints for the presence of brain abnormalities. With modern neuroimaging techniques like MRI, fMRI, PET and SPECT we could expect a more differentiated view regarding cortical and subcortical patterns associated with sexual homicide. However, a recent EEG study on 14 murderers (27) showed empirical utility in addition to neuroimaging findings. EEG revealed significant increases in slow-wave activity

in the temporal, but not in the frontal lobe in murderers, in contrast to prior PET findings that showed reduced prefrontal, but not temporal glucose metabolism.

Our study has several limitations: 1. It was a retrospective study derived exclusively from archival forensic psychiatric reports. 2. Although the population of our study may not be representative of samples from other countries, the size of the sample, the largest reported to date gives some confidence that the identified group differences are unlikely to be due to chance. 3. There was a lack in modern neuroimaging techniques because most court reports were done before 1991. 4. There was a possible bias in selection of offenders (more violent or with pathologic neurological signs) sent to examinations. This was partly confirmed for neuroimaging but not for EEG examinations. 5. The study had no control group of non-sexual homicide perpetrators or non-homicidal sex offenders.

Nonetheless, our study is the first investigating systematically the influence of brain abnormalities in a large sample of sexual murderers. Further research on sexual murderers should evaluate neuro-cognitive aspects associated with frontal and temporo-limbic areas with contemporary neuroimaging techniques.

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